Not all patients are candidates for beating heart procedures. Some patients would require cardiopulmonary support during surgery.
The content and procedural techniques expressed in these materials were prepared at the direction of and/or are based on, the experience and opinions of the respective health care providers presenting. This information is provided as an educational resource to practitioners based on an identified need, but is not intended to constitute medical advice or in any way replace the independent medical judgment of a trained and licensed physician with respect to any patient needs or circumstances. Please see the complete Instructions of Use for products discussed or demonstrated, including all product indications, contraindications, precautions, warnings, and adverse events. These materials are prepared using trained surgeons, who have been using these products regularly within their practices, and the ease of use and outcomes may be different when used by untrained or inexperienced practitioners.
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Introduction and Procedural Guide Objective

For more than a decade, great strides have been made in the evolution of the Off-Pump Coronary Artery Bypass (OPCAB) procedure and in the technologies that allow surgeons to perform the procedure more effectively and efficiently. Many clinical articles citing the benefits of the procedure have been published. In spite of this, opponents of this therapy continue to challenge these benefits. We believe the penetration of OPCAB into total stand-alone Coronary Artery Bypass Grafting (CABG) procedures is less than 25%. Many reasons have been given for the lower-than-expected adoption rate of OPCAB. Many surgeons believe that it is much more difficult to perform a CABG on a beating heart, and that complete revascularization cannot be achieved. Further, it’s often misconstrued that patency rates are lower for beating-heart procedures than arrested-heart CABG procedures. The clinical literature, including the ISMICS Consensus Statement, indicates that complete revascularization and equivalent patency rates are possible for OPCAB procedures when experienced surgeons utilize tissue stabilizers and positioners to complete the procedure.

The purpose of this procedural guide is to highlight the lessons learned from its authors, who have performed over 90% of their cases by utilizing OPCAB. The target audience for this procedural guide is surgeons and anesthesiologists just beginning the implementation of the OPCAB procedure and surgeons who presently perform a limited number of their CABG cases off-pump. The intent is to increase the comfort level of cardiac surgeons and anesthesiologists with the beating-heart procedure and allow them to expand the base of patients upon whom they perform OPCAB.

By becoming more aware of the revascularization strategies and the “tips and tricks” related to hemodynamic management learned over many years of experience, surgeons will shorten their learning curve and enhance their results. This procedural guide discusses preoperative, intraoperative, and postoperative factors that will facilitate more rapid learning, broaden surgeon adoption, and extend the benefits of OPCAB to a wider patient population.

Key Tenets of OPCAB Surgery

While teaching surgeons about the OPCAB procedure over the past 10 years, the authors have developed the following tenets:

- OPCAB is a procedure with demonstrable patient benefits.
- OPCAB is a very teachable procedure.
- There is definitely a learning curve, but the ideas and suggestions found in this document could minimize any negative patient outcomes during the learning process.
  - Outcomes early in the off-pump experience need to be favorable to sustain motivation for the surgeon and referring cardiologists.
- The learning process should emphasize the importance of determining how to safely prevent urgent conversion to conventional arrested-heart CABG.
- To obtain appropriate/complete revascularization of the heart, employ a progressive revascularization strategy.
- Communication with anesthesia and the other members of the OR team is critical.

These tenets will be expanded upon in the remainder of this procedural guide.
Preoperative Procedural Considerations

Procedural Contraindications

- Cardiopulmonary resuscitation
- Cardiogenic shock
- Electrically unstable patient

Relative Procedural Contraindications

The following are relative contraindications for surgeons doing only a small percentage of their CABG patients off-pump. As more experience and comfort are achieved, patients presenting with the following can also be considered:
- Extensive atherosclerosis
- Intramyocardial vessels
- Very small vessels

Preoperative Planning

Review of Angiograms

- Assess angiograms to develop a grafting strategy that will allow for progressive revascularization of the heart, thereby maintaining hemodynamic stability (see Grafting Strategy on page 6).
  - Recognize left vs. right dominance to facilitate grafting strategy.
- If possible, identify collaterals and septal perforators to minimize regional ischemia.
- Assess target vessels for optimal distal target placement.

Intraoperative Procedural Considerations

Patient Preparation

- The anesthetic for off-pump surgery should prepare the patient for early extubation.
  - The best choice to achieve this endpoint is an inhalation anesthetic supplemented with intravenous (IV) narcotics.
  - Induction should emphasize stable hemodynamics. This can be achieved by slow titration of propofol and/or etomidate.
- Maintain anesthesia with an inhalation agent to help decrease myocardial oxygen consumption.
  - Usually 5 to 10 µg/kg of fentanyl is given on induction to supplement analgesia.
- Maintain body temperature.
  - Place warm blankets on patient when possible and keep patient covered until just before prepping.
  - Use heating pads under patient during procedure.
  - Place Bair Hugger® on lower extremities after vein harvest.
  - Keep room warm prior to draping to decrease radiant heat loss.

  NOTE: This may be the most important maneuver to decrease the development of hypothermia.

Patient Preparation

- Maintain normothermia. Place warm blankets on patient “ON-CALL TO OR.”
- Assure appropriate electrolyte balance.
- Patient should not be hypovolemic either pre- or post-op.
– Connect heat moisture exchanger to endotracheal tube.
– Use head wrap.
– Use warm IV fluids.

• Maintain euvolemia.
  – Judicious use of crystalloids will avoid dilutional anemia and transfusions.

• Use patient position, such as Trendelenburg, to facilitate venous return and exposure.

• Maintain electrolyte balance and acid-base status.
  – Replace potassium and magnesium as needed.
  – Use sodium bicarbonate appropriately.

• Maintain adequate oxygen delivery.

• Maintain adequate hematocrit and PaO₂.
  – In order to improve exposure for the surgeon, you may need to ventilate manually during anastomosis of circumflex (and/or RCA). As a result, atelectasis may occur.

• Maintain normal sinus rhythm.
  – Patients frequently come to the OR with sinus bradycardia secondary to pre-op beta-blocker usage.
    • Bradycardia may be good for ischemia prevention but may be problematic during grafting.
    • Consider increasing heart rate either pharmacologically or with a pacemaker after heparinization (not before) to minimize the risk of ischemia.
  – Infuse 2 to 5 grams of magnesium post-induction.
  – Deliver a lidocaine bolus prior to left internal mammary to left anterior descending artery (LIMA-to-LAD) graft.

• Consider amiodarone loading.
  – Inexperienced OPCAB surgeons should consider loading all patients if there is no contraindication.
  – Experienced OPCAB surgeons should load only patients with preoperative arrhythmias and/or low ejection fraction.

• Place pacemaker lead over drape to use if bradycardia or heart block occurs.

• Infusion of nitroglycerin is used for most patients to prevent potential ischemia.

• Maintain mean blood pressure above 60 mm Hg.

Echocardiography

Epiaortic Ultrasound
One of the main advantages of off-pump surgery is the avoidance of aortic manipulation, which can lead to a decrease in postoperative neurologic deficits. Identifying atheroma in the proximal aorta using epiaortic evaluation can prevent placing proximal anastomoses in areas of plaque.

Transesophageal Echo (TEE)
TEE is a very useful adjunct to cardiac surgery. The initial evaluation can identify abnormalities, which may change how the case proceeds. During grafting, TEE loses its usefulness as the heart is frequently not in anatomic position. Between grafts, the TEE can again be used to identify any new abnormalities. TEE may be used during off-pump CABG to do the following:

• Assess regional wall motion abnormalities.
  It is important to identify these abnormalities so that potential new abnormalities can be identified after grafting.

• Assess global left ventricular function.
  By knowing the overall ejection fraction, the practitioner can decide what therapeutic measures may be necessary to maintain adequate hemodynamics.
• Assess intravascular volume status.
  Euvolemia needs to be maintained in order to sustain adequate cardiac output and to prevent postoperative complications, such as acute renal failure.
• Identify occult mitral valve disease, which may worsen with displacement, creating an acute hemodynamic challenge.
  If the disease is significant enough, cardiopulmonary bypass (CPB) will be necessary to repair or replace the valve.
• If mitral valve regurgitation is present, but is mild and/or believed to be secondary to ischemia, certain measures can be taken to ensure adequate hemodynamics during grafting.
  – During the circumflex anastomosis, the heart is positioned in a way that can make it very difficult to maintain adequate cardiac output and blood pressure. Adequate heart rate is necessary to minimize regurgitation.
    – The use of glycopyrrolate or atropine and/or the use of a pacemaker can help achieve this.
    – In addition, a bolus of milrinone prior to grafting may be helpful.
    – Intra-aortic balloon pumps, in general, are very helpful to manage hemodynamics during off-pump surgery, especially for this specific problem.
• The order in which grafting is done can also help minimize regurgitation. Revascularization to other parts of the heart before grafting the circumflex can make this anastomosis easier to achieve.
• Both proximal and distal anastomoses can be performed sequentially as opposed to doing all the distal anastomoses first.

**TIP**
Raise the blood pressure to supranormal levels prior to heart positioning to enable the clinician to have more time to complete the anastomosis if it’s anticipated that the patient will not be able to tolerate this.

Both vasoconstrictor boluses and, in particular, drips can be started prior to positioning.

**TIP**
In certain difficult situations, the surgeon can partially complete the anastomosis, lower the heart, improve hemodynamics, and then finish grafting.

**Identifying Right Ventricular (RV) Dysfunction:**
• RV dysfunction may make it difficult to proceed with off-pump surgery.
• Proceeding with the posterior descending artery (PDA) or right coronary artery (RCA) grafts first, both distal and proximal anastomoses, may help.
• In addition, taking down the pleura on the right side can allow for better hemodynamics when left-side grafting is performed.
• Maintaining a low pulse volume recording (PVR) by using high O2 and alkalis can help with RV dysfunction.
• If left ventricular (LV) hypertrophy is present, which is very frequently seen in this patient population, it may be difficult to graft the circumflex coronary artery (CIRC) and PDA.
  – Anticipation of this will allow the surgeon to prepare for this prior to heart manipulation.
TIP
Maintain Your Comfort Zone
Given that there is a learning curve for an OPCAB procedure, it is important to assure that positive patient outcomes occur. An approach to consider, as experience in OPCAB is accumulated, is to set up the heart-lung machine and have the perfusionist available, if necessary. As a result, you are three cannulation sutures away from going on the heart-lung machine — a one-to-two minute process.

Managing and Ascending the Learning Curve: Prepare for Pump Support

• Have cannulation sutures and cannulae available.
• Maintain primed pump on standby.
• Consider intra-aortic balloon pump (IABP) for patients with poor ejection fractions.
  – It also may be helpful, early on, to use IABP for any case in which multiple grafts will be done, especially posterior vessels.
• In addition, by going on-pump, experience can be gained with the stabilizers and heart positioners by doing the grafts on a beating heart without cross-clamping.

Measures for Hemodynamic Support

• Reposition the beating heart to prevent the following:
  – Preload compromise
  – Displacement-induced ischemia
• Increase preload by utilizing the following:
  – Trendelenberg position
  – Fluid challenge
• Temporary Pacing
  – Facilitates rapid improvement in cardiac output.
  – Should be considered for patients on beta-blockers.
  – Frequently helps with RCA grafting and induced bradycardia.
• Short-acting inotropic use
• IABP use
• Cardiopulmonary bypass without cardioplegia
• Shunting coronary artery
  – Intracoronary shunting
  – Aortocoronary shunting prior to hemodynamic compromise

Grafting Strategy

The following related factors are critical in determining the most appropriate grafting strategy to achieve progressive revascularization:

• Complete/progressive revascularization
• Hemodynamic stability
• Minimal regional ischemia

These factors are intertwined and together maximize the success of an OPCAB procedure. The grafting strategy, as identified below, serves as a guide for cardiac surgeons. Since no two patients have identical coronary anatomies, there will be variations in the order of grafting and in the determination of whether to complete the distal or proximal anastomosis first.
Figure 1. PDA Grafting: The weight of the heart is held by the Starfish™ Evo Heart Positioner which allows for good pre-load blood pressure management.

Figure 2. Arteriotomy on a pressurized coronary artery prior to occlusion.

Figure 3. Arteriotomy after placement of occlusion tape.

Figure 4. OM stabilized and being grafted.

Figure 5. OM1 prepared for sequencing to OM2.

Figure 6. Completed sequencing of OM1-OM2.
Plan and think about the total procedure — the patient’s cardiac anatomy is critical

Patient Anatomy
- 70-year-old male with unstable angina
- 95% occlusion of the LAD
- Completely occluded RCA with reverse collateral circulation from the LAD
- 95% occlusion of the CIRC
- Normal LV function

Example of not grafting the LIMA-LAD first:
The patient has a completely occluded RCA with collaterals going to it from the LAD. Grafting the LIMA-LAD first will cut off the flow to the RCA. Therefore, graft the occluded RCA first, thereby increasing the blood supply to the RCA. In addition, the collateral circulation will flow from the RCA back to the LAD and provide some additional blood supply to that vessel while the LIMA-LAD anastomosis is performed. Then, complete the circumflex anastomosis.

As a result, the procedure is much easier and additional regional ischemia has been avoided.

CAUTION: With the above, a compromise to the left system during manipulation may create global ischemia, positioning the beating heart must be done with careful monitoring of potentially impending ischemia. It may be necessary to reposition the heart a few centimeters either way to avoid ischemia.

Grafting Order

The authors recommend the following grafting sequence:

1. LIMA-LAD: When this graft is performed first, approximately one-third of the heart is vascularized without moving or rotating the heart.
   - Completing this graft first will maintain hemodynamic stability because minimal manipulation of the heart will occur.
   - No heart positioner, deep pericardial suture placement, or sling technique needs to be employed.
   - Make certain that subsequent displacement does not avulse the LIMA-LAD graft.

2. Complete grafting of the diagonal and obtuse marginal (OM) arteries next.
   - These arteries are easy to visualize so minimal repositioning of the heart is required.

3. Complete the grafting of the circumflex artery.

4. With the left-sided vessels completed, proceed to the grafting of the PDA and the right coronary artery (RCA).

Procedural Considerations

As recommended in the ISMICS Consensus Statement:

“With appropriate use of modern stabilizers and heart positioners and adequate surgeon experience, similar completeness of revascularization and graft patency can be achieved with OPCAB.”

The following are recommended ways to use and position tissue stabilizers, heart positioners, and vessel occlusion techniques. Surgeons may adopt their own unique methods for using these devices. What is discussed and shown in this procedural guide is one way to carry out an OPCAB procedure.
Positioning the Beating Heart

Heart Positioners

Heart positioners were developed in order to allow the cardiac surgeon to position the beating heart to maximize access and visualization of the target vessels, while maintaining hemodynamic stability. Using suction to attach the positioning device to the apex or slightly off the apex, on the left ventricle of the heart, allows the heart to be lifted gently or rotated in order to position the target vessel and complete an effective anastomosis. By properly positioning the heart, the surgeon can access all vessels requiring anastomosis, whether on the anterior, lateral, or posterior walls of the heart.

Deep Pericardial Sutures

Deep pericardial sutures, used alone or in conjunction with heart positioners, can facilitate rotation and/or vertical displacement of the heart. The authors recommend that deep pericardial sutures be instituted gradually to avoid sudden pressure drops.

A single deep pericardial retraction suture may be placed behind the coronary sinus superficial to the esophagus and pulmonary vein.

Pericardial Sutures

Pericardial sutures should be kept flaccid during manipulation to prevent any compressive effects on the beating heart.

Consider dissection of the pericardial reflection off the diaphragm when greater displacement is required.

- Open the right pleura so the heart can be herniated into this space to graft the circumflex artery.
- Two fat pads exist along this plane. Dissection through the first generally encounters a small artery.
- The second fat pad encounters the phrenic nerve. Prevent cutting through this fat pad to avoid injury.
- This reflection should be re-approximated prior to closing.

**TIP**

Heart positioners should be attached to the apex or slightly off the apex on the left ventricle, and slow, gentle caudal elongation of the septum should be applied while lifting or rotating the heart. These gentle ing adequate blood pressure. Most blood pressure changes will be seen early in the displacement.

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**Figure 7.**

![Image of Starfish™ Evo Heart Positioner](image1)

![Image of Urchin™ Evo Heart Positioner](image2)

**Figure 8.** Heart Positioner depicting proper elongation of septum for positioning

**Figure 9.** Anastomosis at distal OM and placement of deep pericardial sutures
Stabilizing the Beating Heart

Tissue Stabilizers

While both suction (vacuum) and compression stabilizers are available, using noncompression stabilizers is recommended by the authors. Compression devices may alter the normal geometry of the heart and decrease cardiac output. Hemodynamic compromise from compression devices may also occur.

Noncompression devices have greater headlink and articulating arm flexibility to allow the surgeon to position the stabilizer with greater ease and thus gain access to all target vessels with good visualization of the anastomotic site.

Noncompression stabilizers manufactured by Medtronic also provide a feature (pod spread) to spread the epicardium. Pod spread creates epicardial tension to help produce an optimal arteriotomy and to present the open arteriotomy for grafting. It may also create a Parsonnet-type retractor effect for epicardial fat.

Heart Positioner and Tissue Stabilizer Placement

Device placement on the sternal retractor is determined by each surgeon’s preference. The goal is to maximize visualization and access to the anastomotic site, while trying to keep the articulating arms of each device out of the surgeon’s way. The devices can be placed on both arms as well as the ratchet (gear) side of the Octobase™ retractor. This allows the surgeon to have many options in placing the devices. Some surgeons prefer to reposition one or both of the devices, depending on which coronary artery is being grafted. Other surgeons try to minimize repositioning and keep at least the positioner in the same location on the retractor, minimizing target-to-target time.

From a technique perspective, moving from performing 10% to 70% of your cases off-pump is relatively easy. Surpassing 70% becomes more difficult for both the surgeon and anesthesiologist. Performing these difficult cases should only be considered after significant experience is gained with less difficult cases.

Example of a difficult case:
A large heart with a hypertrophied left ventricle that lies in the left chest may result in significant challenges if performing the case off-pump. For a case like this one, either go on-pump with the heart arrested or perform the case on-pump with the heart still beating. Performing the case on-pump with the heart still beating will give the surgeon additional experience in operating on a beating heart.
Coronary Occlusion

With on-pump CABG surgery, coronary blood flow is stopped when the aortic cross-clamp is placed. In beating-heart CABG surgery, proximal occlusion of the vessel may be required to minimize blood flow so that the surgeon can visualize the anastomotic site and to enhance vessel suturing. Typically, a silastic tape is placed around the coronary artery approximately 1 cm proximal to the anastomotic site. The silastic tape is strategically placed to minimize regional ischemia. The tape can be either clipped down or held with a hemostat (see Figure 3).

**TIP**
Create arteriotomy prior to occlusion. A pressurized coronary may help prevent back-wall injury and over-constriction of occlusion device (see Figure 2).

Visualization/Bloodless Field

**Use of Blower/Mister**

An essential tool for performing beating-heart surgery is a blower/mister. This is a device that typically mixes a pH-balanced solution with a gas such as CO₂ to provide a fine mist that, when sprayed toward the anastomotic site, clears the blood away and allows the surgeon to have an unobstructed field for sewing.

The blower/mister also aids in keeping the arteriotomy open, thereby defining the border of the arteriotomy. The device should be held 5 to 10 cm away from the arteriotomy for effective use. The mist should be aimed across the arteriotomy not directly into the arteriotomy. Warm irrigation fluids should be used to prevent inducing an arrhythmia.

**TIP**
When inserting the shunt, the longer end should be inserted first in the cephalad direction, followed by the shorter end, which should be inserted in the caudal direction. Removal of the shunt should occur in the opposite manner with the shorter end removed first.

**Use of Intracoronary Shunts**

Some surgeons also prefer to use intracoronary shunts to assist in providing distal flow to the coronary artery being bypassed and to assist in creating a bloodless field. Shunts are also helpful in preventing the suture from going through the back wall of the coronary artery. Surgeons who do not use shunts either believe the insertion and removal of the shunt may cause intimal wall damage to the coronary artery, or are those experienced surgeons who have developed their technique to the point where they believe that shunts are unnecessary.

**Figure 12.** Clearview™ Blower/Mister

**Figure 13.** Shunt insertion
Heparin Administration

Heparin administration and reversal are dependent on surgeon experience and patient condition. The following is a recommended pathway utilized by the authors of this procedural guide.

• Early on in the off-pump experience, heparin should be given in a similar dose to that used with arrested-heart CABG procedures, with the possibility that CPB may become necessary. Thus, the goal is to achieve an activated clotting time (ACT) of 400. This can usually be done with 2 mg/kg dosing. More heparin can always be given if necessary.

• When the case is complete, use a half dose of protamine.
  – One half dose of protamine is usually sufficient to reverse completely the heparin in an OPCAB procedure because the patient is normothermic. Hypercoagulation can be avoided by following the adage that you can always give more.

• Aspirin and clopidogrel bisulfate are given to the patient post-op.
  – Plavix® is maintained for 3 months post-op.

TIP

More frequent monitoring of the ACT levels is preferred due to the faster metabolism of heparin in the normothermic patient.

Postoperative Considerations

Extubation

• Typically, reduced doses of narcotics are used during induction of anesthesia in OPCAB cases. Because of this, hypertension and tachycardia may occur earlier in the postoperative period. Thus postoperative narcotics and/or vasodilators may be needed earlier in the postoperative period.
  – Dexmetetomidine is a very useful adjunct in order to achieve adequate analgesia and sedation while allowing early extubation.
    – This infusion is usually initiated during subcutaneous closure.

• Maintain homeostasis as much as possible.

• Do not extubate too soon.
  – As stated, atelectasis may be seen early on post-op since decreased tidal volumes and manual ventilation are used to help the surgeon during difficult anastamoses.
  – A reasonable goal is to extubate the patient between 2 to 3 hours post-op.

Transfer from the ICU

Criteria to transfer the patient out of the ICU is similar to the on-pump arrested-heart patient, although the off-pump patient should be expected to transfer earlier due to the patient being:

• Normothermic
• Euvolemic

Plavix is a registered trademark of Sanofi-Aventis.
Less likely to:
- Have inotropic support
- Have blood transfusions
- Have atrial fibrillation
- Require extended ventilatory support

Less third spacing of fluids, less diuresis required

More likely to ambulate due to:
- Smaller chest tubes, more likely portable reservoirs
- Endoscopic vein harvesting

**OR Team Communication**

Team communication is a critical element in the successful completion of an OPCAB procedure. It is true with all members of the OR team, but is most critical between the surgeon and the anesthesiologist. In contrast to an on-pump CABG procedure, the OPCAB procedure requires the anesthesiologist to proactively maintain stable hemodynamics and rhythm in a potentially rapidly changing environment due to regional ischemia and cardiac manipulation.

The surgeon must let the anesthesiologist know when the heart is being displaced, when the coronary arteries are being occluded, and when a shunt has been inserted or removed. Likewise, the anesthesiologist must keep the surgeon informed about changes in the patient’s pressures, the use of inotropes or vasodepressors, S-T segment or rhythm disturbances, and the patient’s overall condition.

Communication with the PA, scrub nurse, and other OR staff is important due to the dynamics of an OPCAB case and the need to have all staff apprised of what is happening at all times.

**Summary**

This procedural guide has focused on making OPCAB a more reproducible procedure by pointing out the “tips and tricks” acquired by very experienced OPCAB surgeons, who have performed the vast majority of their CABG procedures off-pump for many years. Incorporating the grafting strategies and the other technique-related tips presented in this procedural guide should assist the surgeon in ascending the learning curve on the way to becoming an accomplished OPCAB surgeon.

As more evidence mounts to support the benefits of OPCAB and as increasingly advanced devices to facilitate OPCAB procedures are introduced to the market, the patient, the surgeon, and the hospital could all benefit.
Vascular Technical Support
Tel: (877) 526-7850
Tel: (763) 526-7890
Fax: (763) 526-7888
rs.cstechsupport@medtronic.com

Clearview™ Blower/Mister

Indications: This device is intended for use during procedures when a wound or surgical site must be cleared by non-contact means for improved visibility at the site. Contraindications: This device is not intended for use except as indicated above. Do not use where the effects of an air stream or irrigation mist are contraindicated.

Warnings: Do not exceed inlet pressure of 60 psi (414 kPa). DO NOT USE OXYGEN WITH THIS DEVICE. Use caution when moving the tip of the device closer than 3-cm (1.18-in) to the surgical site. DO NOT ALLOW TIP TO CONTACT TISSUE.

Octobase™ Retractor Rack

Indications: The Octobase Retractor Rack is intended to provide surgical access by retraction of soft and bony tissue. Caution: Federal law (USA) restricts this device to sale by or on the order of a physician. For a listing of indications, contraindications, precautions, and warnings, please refer to the Instructions for Use.

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Starfish™ Evo Heart Positioner

Indications: This product is intended for use during coronary artery bypass grafting operations. The intended function of this product is for positioning the heart. Contraindications: This product is not intended for use except as indicated above. Do not attach device to: Newly infarcted tissue, aneurysmal tissue, directly over a coronary artery, or fragile tissue. Warnings: Patient and procedure selection is the responsibility of the medical professional and the outcome is dependent on many variables, including patient anatomy, pathology, and surgical techniques. The Starfish 2 Heart Positioner is to be used only on the apex and on the left ventricle. Caution: Federal law (USA) restricts this device to sale by or on the order of a physician. For a listing of indications, contraindications, precautions, and warnings, please refer to the Instructions for Use.

Urchin™ Evo Heart Positioner

Indications: This product is intended for use during coronary artery bypass grafting operations. The intended function of this product is for positioning the heart. Contraindications: This product is not intended for use except as indicated above. Do not attach device to: Newly infarcted tissue, aneurysmal tissue, directly over a coronary artery, or fragile tissue. Warnings: Patient and procedure selection is the responsibility of the medical professional and the outcome is dependent on many variables, including patient anatomy, pathology, and surgical techniques. The Urchin Heart Positioner is to be used only on the apex and on the left ventricle. Always support the heart when re-positioning the heart. Caution: Federal law (USA) restricts this device to sale by or on the order of a physician. For a listing of indications, contraindications, precautions, and warnings, please refer to the Instructions for Use.

Important Safety Information

Not all patients are candidates for beating heart procedures. Some patients would require cardiopulmonary support during surgery.